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LISHMENT OF STANDARD AND DECIMAL DIVI- IONS OF WEIGHTS, MEASURES, AND COINS OF THE UNITED STATES

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HEARINGS

BEFORE

THE COMMITTEE ON INAGE, WEIGHTS, AND MEASURES

HOUSE OF REPRESENTATIVES

SIXTY-SIXTH CONGRESS
SECOND SESSION

P104-22

ON

H. R. 12850

ESTABLISH THE STANDARD AND DECIMAL DIVISIONS
OF WEIGHTS, MEASURES, AND COINS OF
THE UNITED STATES

STATEMENT OF MR. SAMUEL RUSSELL

FRIDAY, MARCH 26, 1920

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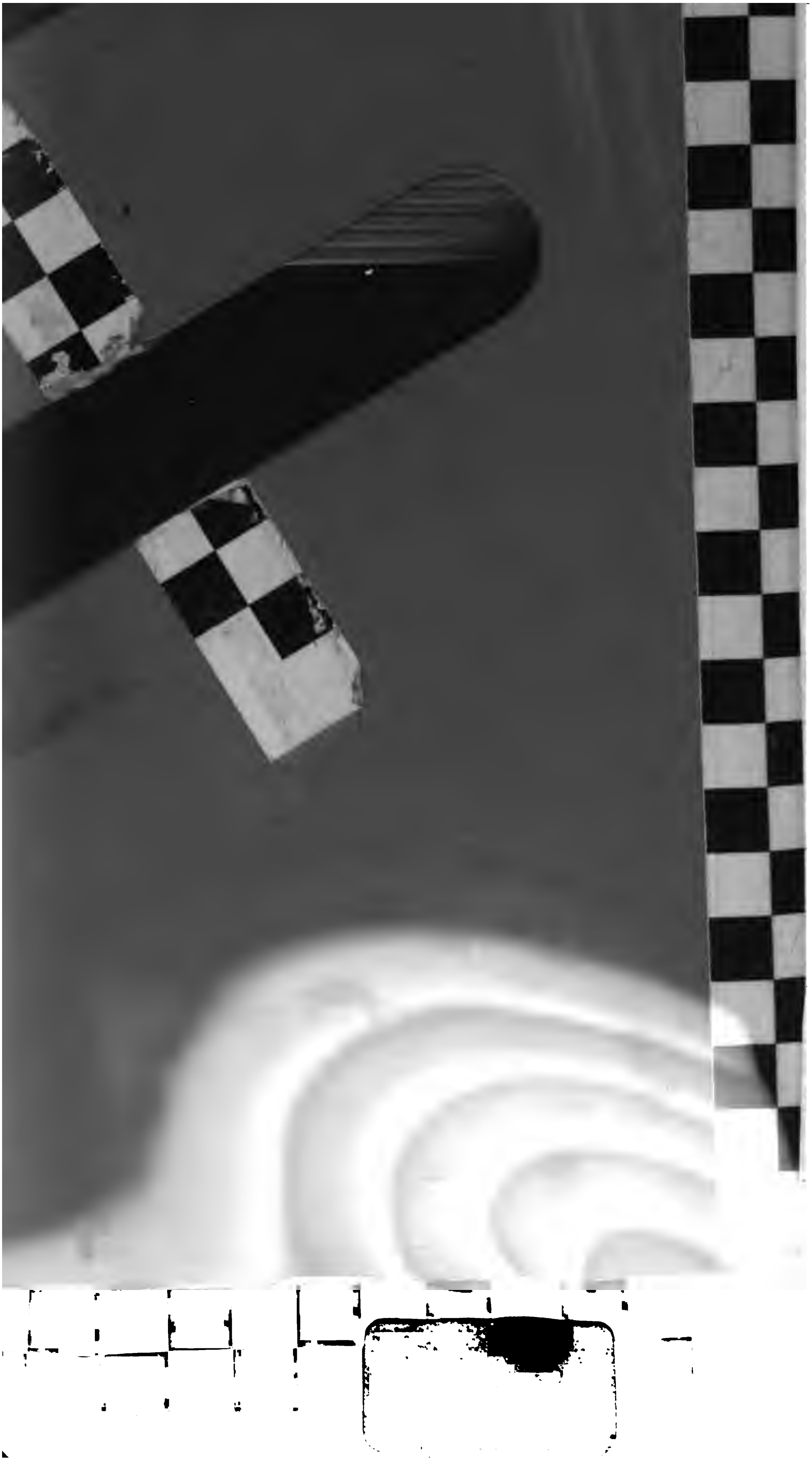

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COMMITTEE ON COINAGE, WEIGHTS, AND MEASURES.

HOUSE OF REPRESENTATIVES.

SIXTY-SIXTH CONGRESS, SECOND SESSION.

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——— ———.

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ESTABLISHMENT OF STANDARD AND DECIMAL DIVISIONS OF WEIGHTS, MEASURES, AND COINS OF THE UNITED STATES.

COMMITTEE ON COINAGE, WEIGHTS, AND MEASURES,
HOUSE OF REPRESENTATIVES,
Washington, Friday, March 26, 1920.

The committee this day met, Hon. Albert H. Vestal (chairman) presiding.

The CHAIRMAN. We will proceed with Mr. Welling's bill, H. R. 12850.

STATEMENT OF HON. MILTON H. WELLING, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF UTAH.

Mr. WELLING. Mr. Chairman, I introduced House bill 12850, at the request of Mr. Samuel Russell, who is present. Mr. Russell desires to make somewhat of an extended statement and it will take, at least, an hour. We are perfectly willing to accommodate the convenience of the committee, and we will be glad to yield when Mr. Walsh comes in for a brief explanation of his bill regarding the coinage.

STATEMENT OF MR. SAMUEL RUSSELL, WASHINGTON, D. C.

Mr. ASHBROOK. What is your business?

Mr. RUSSELL. I am a lawyer and have been a student of politics. I mean politics in its proper not its popular sense.

Mr. ASHBROOK. I would like to inquire what prompted you to have the bill introduced.

Mr. RUSSELL. I have been acquainted for a number of years with Mr. Jefferson's report on weights and measures, made to the House of Representatives when he was Secretary of State in Washington's Cabinet, and with his plan to have a decimal system of weights and measures for the United States based upon the foot. I have had it in mind for a number of years to elaborate a bill for this purpose, with Jefferson's plan as its basis. The metric propaganda which has recently been spread over the country rather prompted me at this time to prepare and present a decimal plan based upon our common foot as preferable to the plan based upon the meter, an American plan that will preserve our present common and convenient measures and give us all the advantages of a true decimal system.

Mr. BRIGGS. You have a rather mixed system here that you have made?

Mr. RUSSELL. It is not mixed except that it supplements our present primary measures by decimal divisions.

Mr. BRIGGS. I mean by that you have no standard such as, for instance, the metric system or the present system. I notice, for instance, here you divide your foot into decimals of 10 decimal inches instead of 12 inches as we now have.

Mr. RUSSELL. The decimal system, of course, makes it imperative to divide the foot by tenths.

Mr. BRIGGS. In other words, you utilize the foot and the yard still and other measures of that kind, but you subject the foot to certain decimal divisions.

Mr. RUSSELL. The standard is the foot just as truly as the standard of the metric system is the meter, and precisely in the same way. Of course, the decimal arrangement makes it imperative to divide the foot into 10 inches or tenths, and hundredths and thousandths.

Mr. BRIGGS. You would have to start educating the people all over again.

Mr. RUSSELL. No.

Mr. BRIGGS. You would have this sort of a system using the foot and teach them the decimal points in the future.

Mr. RUSSELL. It is very simple, as simple as can be; moreover, surveyors have for years been using tenths of the foot, and mechanics have been using hundredths of the inch for fine mechanical work. So we have only to apply the hundredths of the mechanic to the tenths of the surveyor and the trick is done. The printers and typefounders presently use the point to measure and indicate the size of type. The printer's point is about 1.2 decimal points. The decimal system is admitted to be desirable. It is a project as old as the Government itself, and if we are to have a decimal system let us have one that is in conformity to our present primary measures. The bill indeed legalizes and standardizes our present measures. I have not proposed to abrogate or to outlaw any of our present common measures but to make the new decimal divisions permissive just as we now have the metric system permissive by an act of Congress.

Mr. BRIGGS. Why is it not permissive without an act of Congress?

Mr. RUSSELL. Because it is not defined by any law.

Mr. BRIGGS. You mean it is not standardized.

Mr. RUSSELL. It has to be defined in an official way before it can be used.

Mr. BRIGGS. I mean there is nothing to prevent it. You say the surveyors are using it now, and others are using it now, without it being defined by Congress.

Mr. RUSSELL. They have been using it, but yet it could not be commonly used until it is defined by Congress. And moreover we have never had a definition of weights and measures by Congress. Congress has the power, but has failed to exercise it.

Mr. BRIGGS. I think it might have done so advisedly very much like the courts have never construed the police powers; they have made application of them, but except in certain cases did not set out to define them.

Mr. RUSSELL. One of the main reasons for the Union of the Colonies was to bring order into the commerce and trade of the United States, and Congress, for this purpose, was given power to prescribe uniform weights, measures, and coins.

Mr. BRIGGS. I understand that. That is a constitutional provision.

Mr. RUSSELL. It was regarded in those days as very important, but it has never been accomplished. We certainly ought to have a uniform standardized system of weights, measures and coins. We have decimally related coins, of course, now for the whole United States. It is a very proper and sound proposition.

I have brought to the table here a model of cubc of the foot. Each edge of this model [indicating] is 1 foot, each face is a square foot, and the model itself is a cubic foot. The system I have elaborated is based upon the decimal division of the foot. I have here also a model of what I call the decimal inch or the tenth of the foot. The edge is the decimal inch, the face of the model is the decimal square; and the model itself I call the decimal cube, the cube of the decimal inch or the cube of the tenth of the foot.

Now, this decimal cube in my hand [indicating] of water at maximum density, is precisely our present avoirdupois or common ounce; 16 ounces or 16 of these decimal cubes of water make 1 pound; and 16 of these larger cubes, or foot cubes of water, make 1,000 pounds in our present denomination of weights. Thirty-two cubic feet of water make 1 ton. Ten of these decimal cubes [indicating] make 1 foot in the line. One hundred of these [indicating] faces of this small model or decimal cube make a face of the larger one or foot cube, and 1,000 of. these decimal cubes equal the large cube or the cubic foot. I have here also a model of the common inch to visualize the distinction.

You will observe there is no great difference between the common inch and the decimal inch. The decimal inch is precisely one and one-fifth times the common inch or 1.2 inches, so one is convertible into the other by very ready calculation.

The plan has this great utility, it just happened so, but we have taken advantage of it that the decimal cube of water is the present ounce and by assimilating the cubic inch, or this decimal cube to the ounce we get a conversion of the measure of length into the measure of weight and also decimalize the foot into 10 parts. And these two facts, which I did not invent make possible a perfect decimal system based upon those two units without changing our present foot and without changing our present ounce, so that all the new measures proposed in this bill are related decimally to the foot and to the ounce.

The foot is the unit from which the whole sysem is derived. One-tenth of the foot, or the decimal inch, is the primary division in the system. The square of the decimal inch is called the decimal square, and the cube of the decimal inch is called the decimal cube. The decimal cube of water at maximum density is the ounce. The ounce is divided into 1,000 grains, or, more properly, decimal grains, and the cube or cubic foot of water at maximum density is equal to 1,000 ounces and is called the weight unit. Thirty-two of these weight units constitute 1 ton.

It is intended that the decimal grain will be the unit for fine weights in the mechanical and chemical sciences, the ounce the unit for retail trade weights, and the weight unit for the measure of gross weights. It is intended that the point, 1,000 of which are equal to 1 foot, and 100 of which are equal to the decimal inch, will be the unit for fine mechanical and scientific measuration, in place of the fraction of an inch, the centimeter, and the millimeter.

Mr. BRIGGS. In this connection is there any special demand from the industries or from the people for this legislation?

Mr. RUSSELL. There is a demand for a decimal system. This is the principal point in the propaganda for the metric system.

Mr. BRIGGS. I am not talking about the metric system, but about this one you are at.

Mr. RUSSELL. There has hardly been time to test that. This was only offered here on the 2d of March, just 24 days ago.

Mr. BRIGGS. It is in too highly an experimental stage for the advocates of the bill to know anything about it.

Mr. RUSSELL. I would not call it experimental. I would say it is new. It is an endeavor to rationalize, systematize, and render scientific our present measures.

Mr. BRIGGS. I understand that. That is your contention.

Mr. RUSSELL. Yes.

Mr. BRIGGS. But it has not been known sufficiently that people have had an opportunity of testing it out.

Mr. RUSSELL. It was proposed in its essentials by James Watt in 1783, and by Thomas Jefferson in 1790.

Mr. BRIGGS. It has not been adopted since that time, and that is over a century ago.

Mr. RUSSELL. It has not been. I will say that the defect in our present system of measures is that we do not have standard divisions or units sufficiently fine for scientific purposes. We do not get down below inches and for sundry scientific purposes we require also the decimal relation of the units. That is the reason why the centimeter which I have in my hand [indicating], the cubic centimeter, has been desired by scientists because it is finer in magnitude, and one of the big points in favor of the metric system from the standpoint of some of the scientists, is that the measure of volume may be converted in the measure of weight. That is to say, that this cubic centimeter of water is a gram, the metric gram. This little thing here, about the size of crap shooters' dice [indicating]—that is the nearest thing I know to it in our ordinary observation, gentlemen—is the actual basis of the metric system. It is not the meter, but the centimeter which is really the basis of the metric system. It is this [indicating]. One hundred of these little things make a meter in length and the metric scale is divided into these centimeters. The centimeter is used for all linear magnitudes of less than 40 inches. The proposition is to substitute it for our common foot and our inch and in the future to have in their stead this little thing here, one edge of that [indicating], about two-fifths of a common inch. The centimeter is divided into 10 millimeters, and is almost exactly one-third of the decimal inch. The cubic centimeter of water is the gram and 1,000 of these grams [indicating] make a kilogram, the kilogram of the metric system; 1,000 of these cubic centimeters [indicating] in capacity make a liter. Here is a cubic decimeter [indicating] or liter which of water is equivalent to a kilogram. The liter with logical metric consistency should be called the kilokubicentimeter.

The millimeter and the cubic centimeter have been preferred in the laboratory only because our common system had no conversion of units of capacity into units of weight, and moreover have no fine units below the inch, or units decimally related to the standard foot. With our common system standardized, decimalized, and legalized, it will be scientifically complete and adequate for all purposes.

So the controversy resolves itself into a comparison between the centimeter and our present measures of the inch and the foot. The plan which is here proposed is to decimalize the foot. It is not proposed to interfere with the common multiples or fractions of the foot. The bill legalizes our present common English measures, the foot, inch, yard, fathom, rod, furlong, mile, ounce, pound, and ton. It will be left optional with the people to deal with the foot either decimally or duo-decimally, just as may accommodate their needs and preference.

Mr. KELLER. Under your plan 10 of those will be 1 foot.

Mr. RUSSELL. Ten decimal inches equal 1 foot. I may say that for scientific purposes we have divided the decimal inch into 100 points. Therefore we may say in practice 100 points and thus avoid any confusion between the decimal inch and the common inch. A point will be a nice measure for fine scientific and mechanical work. You can say 100 points instead of decimal inch. One thousand points equal 1 foot.

I will say further that the old French foot or pied was divided into inches or pouses, lines and points, 12 points being 1 line, 12 lines being 1 pouse, and 12 pouses 1 foot.

Mr. Jefferson in his plan divided the foot into inches, lines, and points, 10 points being 1 line, 10 lines 1 inch, and 10 inches 1 foot. That is the system laid down in this bill. It is the plan of Jefferson and only varies from the old French customary system by the fact that 10 is used instead of 12 in the divisions. So we are really returning in this scheme, to the old and original system of measurements. It is not the English system, gentlemen. It is a resumption of the system of Imperial Rome, which was carried, like Roman law, throughout Europe. It was carried by England to all the British colonies and by Spain into Spanish America, so the Roman system of the foot and inch became universal throughout the world. In every language of the civilized countries, there are words in which we may translate the terms foot and inch perfectly. The points and lines are perfectly analagous to the old French points and lines, which even to this day persist in France despite the metric system being established by law.

Mr. KELLER. What was the advantage of changing this system to 12 inches at that time in France? It was 10 in France.

Mr. RUSSELL. It was 12 in France. Jefferson proposed the 10 system.

Mr. KELLER. It was an invention.

Mr. RUSSELL. The French system was 12 points to the line, 12 lines in the inch, 12 inches to the foot. That is the old French system. That was changed to 10 by Jefferson, and in this bill we have used 10 to make it decimal.

The foot, inch, line, and point among measures are the exact counterparts of the dollar, dime, cent, and mill among our coins. Jefferson's decimal system for coinage was adopted. We should now complete the decimal system by the adoption of his decimal series of linear measures.

This bill invokes the power of Congress under section 8 of Article I of the Constitution, which reads as follows:

> The Congress shall have the power * * * to coin money, regulate the value thereof and of foreign coins and fix the standard of weights and measures.

The CHAIRMAN. I think, Mr. Russell, if I may interrupt, it is not necessary to go into the legal phase of the power of Congress to regulate this matter because that has been thrashed out in the House.

Mr. RUSSELL. I merely mention it.

The CHAIRMAN. It has been absolutely determined that Congress has the right to fix weights and measures.

Mr. RUSSELL. I only desire to mention that by way of introduction. I am not going to discuss it at all.

In the Articles of Confederation, which were adopted in 1778, and which were in force before the Constitution, this provision appears:

> The United States in Congress assembled, shall have the sole and exclusive right and power of regulating the alloy and value of coins struck by their own authority, or by that of the respective States, fixing the standard of weights and measures throughout the United States.

Of course, gentlemen, there was a reason for inserting those provisions in the first and second Constitutions of the United States. The Articles of Federation were really our first Constitution. In conformity to this plan or this policy, rather, President Washington in his first annual address to Congress, January 8, 1790, had this to say:

> Uniformity in the currency, weights, and measures of the United States is an object of great importance and will, I am persuaded, be duly attended to.

The Senate of the United States in its reply to President Washington—it was customary in those days for the Senate so make reply to the President after the regal custom of England—the Senate said this, on January 11, 1790:

> The uniformity of the currency and of weights and measures, the introduction of new and useful inventions from abroad, and the exertions of skill and genius in producing them at home, the facilitating the communication between the distant parts of our country by means of post offices and post roads * * * are objects which shall receive such early attention as their respective importance requires.

President Washington again urged this subject upon Congress in his second annual address, December 8, 1790:

> The establishment of the militia, of a mint, of standards of weights and measures, of post offices and post roads are subjects which I presume you will resume, of course, and which are abundantly urged by their own importance.

Again, in his third annual address, October 29, 1791, President Washington said:

> An uniformity in the weights and measures of the country is among the important objects submitted to you by the Constitution, and if it can be derived from a standard at once invariable and universal, must be no less honorable to the public councils than conducive to the public convenience.

In conformity to this policy and these suggestions, Thomas Jefferson, who was then Secretary of State in the cabinet of President Washington, made on the 4th day of July, 1790, a report of a plan for establishing uniformity in the coinage, weights and measures of the United States, which was communicated to the House of Representatives, July 13, 1790. I desire to put into the record material excerpts from Jefferson's report which have a bearing upon the provisions of the pending bill.

Mr. BRIGGS. Mr. Chairman, it is very nearly 12 o'clock now and I personally have to leave. I presume there will be no action on this now?

Mr. RUSSELL. I do not ask any action at this time. I simply want to get the matter before the committee.

The CHAIRMAN. Mr. Russell, do you desire to go ahead and put it in the record now so that we can have in the hearings your further statement, or would you rather suspend and take it up at the next meeting of the committee?

Mr. RUSSELL. I think, gentlemen, that I have most of my material in notes. These will need revision and arrangement. I have hastily put them together and I will be satisfied to put them into the hands of the stenographer with such dictation as I may have to make, and have them compiled in that way as a part of this hearing.

Mr. BRIGGS. That is perfectly agreeable to me, to complete your argument and submit it to the stenographer.

The CHAIRMAN. Yes. If you desire to go along further with any oral statement here, there will probably be some of the members who will stay a little longer or we can put it in the record

Mr. RUSSELL. This first quotation from Jefferson's Report is upon the question of the ascertainment of the standard from the natural world:

> The globe of the earth itself, indeed, might be considered as invariable in all its dimensions and that its circumference would furnish an invariable measure; but none of its circles, great or small, is accessible to measurement through all of its parts, and the various trials to measure definite portions of them have been of such various results as to show there is no dependence upon that operation for certainty.
>
> Matter, then, but its mere extension, furnishing nothing invariable, its motion is the only remaining resource.
>
> The motion of the earth round its axis, though not absolutely uniform and invariable, may be considered as such for every human purpose. It is measured obviously but unequally by the departure of a given meridian from the sun and its return to it, constituting a solar day. Throwing together the inequalities of solar days, a mean interval or day has been found and divided by very general consent into 86,400 equal parts.
>
> A pendulum, vibrating freely, in small and equal arcs, may be so adjusted in its length, as by its vibrations, to make this division of the earth's motion into 86,400 equal parts, called seconds of mean time.
>
> Such a pendulum, then, becomes itself a measure of determinate length, to which all others may be referred to as to a standard.
>
> But even a pendulum is not without its uncertainties.
>
> * * * * * * *
>
> The measures of capacity in use among us are of the following names and proportions: * * * Two quarts a pottle; 2 pottles a gallon; 2 gallons a peck, dry measure; 8 gallons make a measure called a firkin in liquid substances, and a bushel dry.
>
> * * * * * * *
>
> Two barrels * * * make a measure called a hogshead liquid, or a quarter dry; each being the quarter of a ton; 2 hogsheads make a pipe * * * and 2 pipes make a ton.
>
> * * * * * * *
>
> Of the standard measures before stated, two are principally distinguished in authority and practice. The statute bushel of 2,150 cubic inches, which gives a gallon of 268.75 cubic inches; and the standard gallon of 1601, called the corn gallon of 271 or 272 cubic inches, which has introduced the mercantile bushel of 2,276 inches. The former of these is most used in some of the grain States, the latter in others. The middle term of 270 cubic inches may be taken as a mutual compromise of convenience and as offering this general advantage—that the bushel being of 2,160 cubic inches, is exactly a cubic foot and a quarter, and so facilitates the conversion of wet and dry measures into solid contents and tonnage, and simplifies the connection of measures and weights, as will be shown hereafter. It may be added in favor of this as a medium measure, that 8 of the standard, or statute, measures before enumerated are below this term and 9 above it.
>
> * * * * * * *
>
> Let the measures of capacity, then, for the United States be a gallon of 270 cubic inches, the gallon to contain 2 pottles, the pottle 2 quarts, the quart 2 pints, the pint 4 gills, 2 gallons to make a peck, 8 gallons a bushel or firkin.
>
> * * * * * * *

Water and vinous liquors, which enter most into commerce, are so nearly of a weight that the difference, in moderate quantities, would be neglected by both buyer and seller, some of the wines being a little heavier and some a little lighter than water.

Another remarkable correspondence is that between weights and measures. For 1,000 ounces avoirdupois of pure water fill a cubic foot with mathematical exactness.

* * * * * * *

Let the second rod, then, as before described, be the standard of measure, and let it be divided into five equal parts, each of which shall be called a foot; for perhaps it may be better generally to retain the name of the nearest present measure where there is one tolerably near. It will be about one-quarter of an inch shorter than the present foot.

Let the foot be divided into 10 inches, the inch into 10 lines, the line into 10 points. Let 10 feet make a decad, 10 decads 1 rood, 10 roods a furlong, 10 furlongs a mile.

* * * * * * *

Let the unit of capacity be the cubic foot, to be called a bushel. It will contain 1620.05506862 cubic inches, English; be about one-fourth less than that before proposed to be adopted as a medium; one-tenth less than the bushel made from 8 of the Guildhall gallons; and one-fourteenth less than the bushel made from 8 Irish gallons of 217.6 cubic inches.

Let the bushel be divided into 10 pottles, each pottle into 10 demipints, each demipint into 10 meters, which will be of a cubic inch each. Let 10 bushels be a quarter and 10 quarters a last, or double ton.

The measures for use being four-sided, and the sides and bottoms retangular, the bushel will be a foot cubic. The pottle 5 inches square and 4 inches deep; the demipint 2 inches square and 2½ inches deep; the meter an inch cube.

WEIGHTS.

Let the weight of a cubic inch of rain water, or the thousandth part of a cubic foot, be called an ounce; and let the ounce be divided into 10 double scruples. The double scruple into 10 carats, the carat into 10 minims or demigrains, the minim into 10 mites. Let 10 ounces make a pound, 10 pounds a stone, 16 stones a kental, 10 kentals a hogshead.

* * * * * * *

MEASURES OF LENGTH.

	Feet.		Equivalent in English measure.
The point,	0.001	=	0.011 inch.
The line,	.01	=	.117.
The inch,	.1	=	1.174, about $\frac{1}{7}$ more than the English inch.
The foot,	1,	=	11.744736 .978728 feet About $\frac{1}{48}$ less than the English foot.
The decad,	10,	=	9.787, about $\frac{1}{48}$ less than the 10-foot rod of the carpenters.

James Watt has been widely exploited in metric propaganda as the inventor of the metric system. There is distributed by anonymous German interests a booklet with a lurid title, "Keep the World War Won," adorned on the title page with a highly colored picture of James Watt, the alleged father of the metric system, which states that the metric system is not German; but that the English system is German. It is, in fact, not English; it is the Roman system. It is interesting to note in this connection what Watt really said upon the question of weights and measures. I have carefully examined four biographies of James Watt and find that the only written memorials of his views on weights and measures are a letter to Mr. Kirwan in November, 1783, in which he proposed that the ounce be divided into 1,000 grains and multiplied by 10 into the philosophical international pound, and a letter to Mr. Magellan in which he proposed a decimal system, based on the foot and the ounce.

He wrote to Mr. Kirwan, November, 1783:

I had a great deal of trouble in reducing the weights and measures to speak the same language; and many of the German experiments become still more difficult from their using different weights and different divisions of them in different parts of that

Empire. It is therefore a very desirable thing to have these difficulties removed, and to get all philosophers to use pounds divided in the same manner, and I flatter myself that may be accomplished if you, Dr. Priestly, and a few of the French experimenters will agree to it; for the utility is so evident, that every thinking person must immediately be convinced of it.

Let the philosophical pound consist of 10 ounces or 10,000 grains; the ounce consist of 10 drachms or 1,000 grains; the drachm consist of 100 grains.

Let all elastic fluids be measured by the ounce measure of water, by which the valuation of different cubic inches will be avoided, and the common decimal tables of specific gravities will immediately give the weights the of those elastic fluids.

If all philosophers can not agree on 1 pound or 1 grain, let everyone take his own pound or his own grain; it will affect nothing but doses of medicines, which must be corrected as is now done; but as it would be much better that the identical pound was used by all. I would propose that the Amsterdam or Paris pound be assumed as the standard, being now the most universal in Europe: It is to our avoirdupois pound as 109 is to 100. Our avoirdupois pound contains 7,000 of our grains, and the Paris pound 7,630 of our grains, but it contains 9,376 Paris grains, so that the division into 10,000 would very little affect the Paris grain. I prefer dividing the pound afresh to beginning with the Paris grain, because I believe the pound is very general, but the grain local.

Dr. Priestly has agreed to this proposal, and has referred it to you to fix upon the pound if you otherwise approve of it. I shall be happy to have your opinion of it as soon as convenient, and to concert with you the means of making it universal. * * * I have some hopes that the foot may be fixed by the pendulum and a measure of water, and a pound derived from that; but in the interim let us at least assume a proper division, which from the nature of it must be intelligible as long as decimal arithmetic is used.

The letter to Mr. Magellan:

As to the precise foot or pound, I do not look upon it to be very material, in chemistry at least. Either the common English foot may be adopted according to your proposal, which has the advantage that a cubic foot is exactly 1,000 ounces, consequently the present foot and ounce would be retained; or a pendulum which vibrates 100 times a minute may be adopted for the standard, which would make the foot 14.2 of our present inches, and the cubic foot would be very exactly a bushel, and would weigh 101 of the present pounds, so that the present pound would not be much altered. But I think that by this scheme the foot would be too large, and that the inconvenience of changing all the foot measures and things depending on them, would be much greater than changing all the pounds, bushels, gallons, etc. I therefore give the preference to those plans which retain the foot and ounce.

The desirability of a decimal arrangement was thus clearly perceived by James Watt, the great British engineer and mechanician. In November, 1783, he proposed the international "philosophical pound" of 10 ounces and the division of the ounce into 1,000 grains. The ounce to which Watt referred is the weight of the cube of one-tenth of the foot of water at maximum density. Watt was quick to perceive this decimal relation between the foot and ounce and proposed that the measure of weight be thus derived from the measure of length. Watt expressly stated that the proper plan for an ideal decimal system should retain the foot and the ounce.

The great desideratum is to preserve our customary units of measure and weight and to bring the divisions of the same into proper decimal relations. This will afford all the advantages of the decimal features of the metric system and preserve for us the great convenience of our own common measures. Inasmuch as these common measures are practically universal in all countries they afford the only true basis for a real international system.

It is absolutely certain from these records that Mr. Watt was never in favor of the metric system, but was specifically in favor of a decimal system founded upon the foot and the ounce divided decimally into appropriate units. It is equally false to claim that Washington, Jefferson, or Franklin approved the metric system.

I have not made a personal search through the works of Franklin to ascertain whether or not he made any references to the subject of weights and measures. It is morally certain that he had nothing to do with the metric system.

I will put in the record a letter from the Library of Congress to the effect that a search in the library has not disclosed any reference by Benjamin Franklin to the question of the metric system, notwithstanding that Franklin is exploited with Thomas Jefferson and Watt as having favored the metric system.

(The letter referred to is as follows:)

LIBRARY OF CONGRESS,
Washington, March 18, 1920.

In response to your inquiry relative to a possible statement by Benjamin Franklin favoring the metric system, we have made a careful search of the following works:

Smyth—Life and Works of Benjamin Franklin.
Bigelow—Life and Works of Benjamin Franklin.
Sparks—Life and Works of Benjamin Franklin.
Franklin's Autobiography.
Ford—Bibliography and Index.

We have also looked through several works on the history of the metric system and in the publications of the American Metrological Society.

We have found no reference by Benjamin Franklin to the metric system and no statements attributed to him on this subject. It is possible, however, that there may be in existence some obscure pamphlet or the like bearing on the question but we have been unable to discover anything here.

Yours, very respectfully,

C. W. COLLINS,
Legislative Assistant.

I will now proceed with the statement I have prepared upon the proposed decimal system of weights and measures.

AN AMERICAN SYSTEM OF WEIGHTS AND MEASURES.

Congress has never exercised the authority conferred by section 8 of Article I of the Constitution to fix the standard of weights and measures for the United States. One of the principal motives for the union of the colonies was to bring order into the internal commerce of the country and a uniform standard system of money, weights, and measures was regarded as a primary and essential step in this program. The Articles of Confederation of 1778 conferred upon Congress, or upon the United States in Congress assembled, the sole power of fixing weights and measures throughout the United States. President Washington in his first message to Congress recommended that the power to fix weights and measures be exercised. With this object in view Thomas Jefferson, then Secretary of State, prepared, under date of New York, July 4, 1790, "A plan for establishing uniformity in the coins, weights, and measures of the United States." In this plan Jefferson laid down a complete decimal system for the coinage, weights, and measures of the United States. He divided the foot on the decimal system into inches, lines, and points, the point being the thousandth part of the foot, 10 points constituting 1 line, 10 lines 1 inch, and 10 inches 1 foot. Jefferson's plan was very elaborate, covering the whole field of weights and measures, all derived from the foot standard. The only part of the Jefferson plan that was adopted was the decimal system for the coinage, comprehending the dollar, dime, cent, and mill in decimal relations. We have departed from this in the coinage of half dollars and quarters, which are not decimal divisions of the dollar.

Jefferson brought out the fact that the ounce was the one-thousandth part of the weight of a cubic foot of water, by reason of which fact it was possible to bring the system of weights into decimal relation to the measures of length, surface, and volume.

The Unabridged Dictionary contains more than 1,000 denominations of coins, weights, and measures which have come down to us from the commercial practice of the different countries of the world.

John Quincy Adams, when Secretary of State, in the administration of James Monroe, on February 22, 1821, submitted to the Senate an extensive report and review of the systems of weights and measures in use in the various countries in the world. It would serve no useful purpose to discuss these heterogeneous measures. It would, indeed, be but multiplying confusion to do so.

The two measures which gained a place in the world upon the point of their utility and convenience were the cubit of ancient Egypt and Assyria and the pes or foot of Rome. Following Roman practice the foot became the customary unit for the whole of Europe and for the English and the Spanish colonies in the Western Hemisphere. The cubit and the foot are both adapted by their respective magnitudes for practical mensuration. The foot was taken from the length of the human foot; it is about equal to one of our modern No. 10 shoes. The English foot of 12 inches in length is known throughout the world. It has become the standard foot. The average cubit was equal to about 18 inches or 1½ feet. Either of these measures might have been a practical base for a decimal system of mensuration.

In the experience of governments and commercial practice, two facts have been clearly developed. The primary necessity, of course, is for a convenient measure of length. Experience and custom has conclusively established the English foot as the most convenient measure of length. The foot has in fact become the standard unit and practically all measures of length are now referred to the foot. The preference of the foot over the yard has been clearly demonstrated by the progressive obsolescence of the yard as a unit of common measure. The second fact brought out by experience is the utility of the decimal notation in computations involving fractions or divisions of the unit or standard. The decimal notation has no proper office, however, when applied to multiples of the unit standard or integer of measurement. It therefore has no special utility when applied to the multiples of the foot, just as it has no special utility when applied to the multiples of the dollar. We have long since abandoned the use of eagles and double eagles and now count only dollars. We have likewise abandoned the use of the dime as a decimal division of the dollar and have seized upon the more convenient cent, and for fractions of the dollar count now only cents or hundredths, which, of course, may be converted into dimes by merely placing the decimal point. The problem is therefore to arrange a system of weights and measures derived from the foot and with proper decimal divisions of the foot to complete the system. It is only in the field of the divisions or fractions of the standard that the decimal notation need be applied. It has no utility outside this purpose, nor is there a need for the multiplicity of decimal divisions. The ones most convenient for scientific and fine mechanical measures need only be provided.

The decimal system provided by the pending bill has as its primary units for the measure of length, surface, volume, and weight, the foot, the square, the cube, and the weight unit, which are, respectively, the foot length, the square of the foot, the cube of the foot, and the weight of the cube of the foot of water at maximum density. The secondary units or decimal divisions are the decimal inch, the decimal square, the decimal cube, and the ounce, which are, respectively, the tenth of the foot or the decimal inch, the square of the decimal inch, the cube of the decimal inch, and the weight of the decimal cube of water at maximum density, which are designed to be the secondary or decimal units for the measure of length, surface, volume, and weight. Ten decimal inches equal 1 foot, 100 decimal squares equal 1 square, 1,000 decimal cubes equal 1 cube, 1,000 ounces equal 1 weight unit, the weight of the cube of water. The ounce is our present avoirdupois ounce. For fine weights it is divided into 1,000 grains, so we have 1,000 grains equal 1 ounce, 1,000 ounces equal 1 weight unit, 32 weight units equal our present ton. The tenth of an ounce is called a dram; 100 grains equal 1 dram; 10 ounces equal 1 decimal pound; 100 decimal pounds equal 1 weight unit. The present avoirdupois pound of 16 ounces is recognized and legalized. One hundred pounds is equal to 1.6 weight units and by the use of this ratio we have an easy means of converting weight units into hundredweights, and hundredweights into weight units.

The changes which the decimal system will cause, will be the substitution of ounces for pounds in retail trade and of points for fractions of the inch, centimeters, and millimeters in mechanics. The line or the hundredth of the foot may well be eliminated in practice, because it is easier to say "10 points" than to say "1 line" and it is also easier to say "100 points" than to say "1 decimal inch." The use of the common inch will not be interfered with by law, and the decimal inch may be denoted as 100 points to avoid any confusion with the inch. We will then have in mechanics the present common inch which is a duodecimal division of the foot and the point which is a decimal division and which by multiplication can be adapted to any measure within the foot and without interfering with the customary use of the common inch.

It is therefore to be expected from the adoption of the new system that the point will become employed for fine mechanical mensuration in place of fractions of the inch and of centimeters or millimeters. One thousand points equal 1 foot, and 100 points equal 1 decimal inch. The point will therefore be a very nice and practical unit for fine mechanical purposes. Indeed it will be as perfect a unit as could be desired. Ten points is a better designation than is 1 line. The line is retained merely for the sake of uniformity. The better practice will be to count points rather than split or divide the foot or decimal inch. The use of the point could readily be adopted by the mechanical trades, and could be used to express all fine measurements now used.

The other change which should follow would be to adopt the customary use of the ounce in place of the pound for retail trade. Prices should be stated in ounces rather than in pounds, and purchases made accordingly. Articles sold by weight do not ordinarily come in pound containers, but must be measured into pounds or fractions of pounds from larger masses. It is obvious that the ounce is the preferable unit to the pound for the purposes of retail trade. Thus candy at 50 cents per pound would better be priced 3 cents per ounce, thus enabling the purchaser to order the exact amount required in ounces with ready knowledge of the amount to be paid. Multiples of the ounce could be used to denote any amount required. Thus 20 ounces would be 1¼ pounds, and 100 ounces would be 6¼ pounds.

If one desires to purchase a pound he may ask for 16 ounces, if he desires to purchase a half pound he may ask for 8 ounces, and if he desire to purchase a quarter pound he may ask for 4 ounces. The pound really is not a convenient measure of weight for retail quantities. The constant practice of splitting the pound demonstrates this fact. The pound is too large for fine weights and too small for gross weights. It is not convenient as the unit for retail trade weights. The pound should therefore become restricted in use in the decimal system of weights, leaving the system to be founded systematically upon grains, ounces, and weight units, 1,000 grains to equal 1 ounce and 1,000 ounces to equal 1 weight unit.

It is precisely as easy to count ounces as to count cents and to designate a desired weight or quantity for retail purchase in ounces as it is to designate the price in cents. A pound, it is true, may split into halves, quarters, and eighths, but the price per pound unless it be 40 cents can not be so divided. If an article is priced at 45 or 35 or 25 cents per pound and the purchaser wants a part of a pound, he will ask for 15 cents worth or some other multiple of 5 cents and will not know the quantity he is purchasing but only the money he is to pay, and even if he would the storekeeper can not divide the pound the same way in which the price is divided. It would rectify all this uncertainty if the price were stated in cents per ounce and have the customer order the exact number of ounces he desires with full knowledge of the quantity he is to obtain and the price he is to pay.

The law should require the portions of food served by public restaurants to be defined in ounces, so as to prevent the petty frauds which are prevalent in the restaurant trades.

The grain is intended to be the unit for fine mechanical and scientific weights, the ounce to be the unit for retail-trade weights, and the weight unit for gross weights. The weight unit, or "weight" of 1,000 ounces, is equal to the cube of water at maximum density. It is a real weight and could in practice be multiplied to denote any weight required. Thirty-two weight units equal the present ton, so that weight units may readily be converted into tons, and conversely tons may be readily converted into weight units; 16 weight units equal 1,000 common pounds and 8 weight units equal 500 common pounds. We have therefore in this system a unit which may be completely and readily accommodated to the requirements of science and mechanics, a unit which meets the requirements of retail trade and a unit which is a real weight unit and as such well accommodated to the determination of gross weights. It is difficult to see how these requirements could severally be more completely accommodated than by the grain, ounce, and weight units, which meet every requirement of utility, convenience, and custom.

We count in tens but break or divide on the binary system into halves, quarters, eighths, sixteenths, and thirty-seconds. The arrangement of the unit for division as distinguished from addition, in twelve parts will yield even halves, thirds, quarters, sixths, twelfths, and their multiples. Counting units and breaking into parts are two distinct mental operations. The first method by addition or computation proceeds upon the decimal arithmetical system. The second proceeds by division upon a binary or duodecimal system or breaking the units successively into halves, thirds, quarters, sixths, eighths, twelfths, sixteenths, thirty-seconds, etc.

There is therefore an important difference between a computation involving the addition or multiplication of small units and one involving division or separation of a whole measure into aliquot or convenient parts. The one process is by counting units according to the rules and principles of decimal arithmetic. We count and multiply in a decimal system. In breaking a larger unit, however, into separate parts, we naturally and instinctively follow the binary system which proceeds by separation into halves, quarters, eighths, sixteenths, thirty-seconds, etc. For permanent fractions of this character we have adopted the duodecimal system of division into twelve parts, thus the dozen of customary use is 12 units, the dial of the clock is divided into 12 hours, the foot is divided into 12 inches, the old French inch is divided into 12 lines, and the French line into 12 points. There are 12 divisions of the zodiac, each with its own distinctive sign. The year is divided into 12 months and the circle into 360°, which is a multiple of 12 and therefore in accord with the duodecimal system.

In the customary transactions of trade it is usually as convenient to count small units as to split or break larger integral quantities. The notable exception is the customary breaking of bushels or other measures of dry commodities into aliquot parts on the binary system.

There is an inveterate and indeed natural custom to deal with measures of dry commodities for consumption in this manner, and this custom should not be ignored but should rather be accommodated in any reform of our system of measures. The proposed unit of volume for the measure of dry commodities is the foot cube. In conformity to the binary system and practice, the cube is divided into halves, quarters, eighths, sixteenths, and thirty-seconds, called, respectively, demicubes, pecks, gallons, pots, and quarts. The cube is equal to 32 quarts, 16 pots, 8 gallons, 4 pecks, or 2 demicubes.

In the decimal system the pint equals 10 liquid ounces or 10 decimal cubes. The third of the quart in the binery system equals $10\frac{5}{12}$ decimal cubes. The relation between the third of a quart and the decimal pint is that of 25 to 24. A peck is equal precisely to 25 pints or 24 third quarts. One quart will divide without loss into three decimal pints, so we have here an approximately aliquot relation between the pint of the decimal system and the quart of the binary system. For all practical purposes, quarts may be converted into pints, or pints into quarts.

The proposed bushel is equal to $1\frac{1}{4}$ cubes or 1,250 decimal cubes. The bushel is therefore equal to 5 pecks, 10 gallons, 20 pots, or 40 quarts. The common bushel is thus retained in the system and the aliquot binary parts of the cube become in effect decimal divisions of the bushel. By this arrangement the two systems are recognized and brought into convenient relation, and the dry measures perfectly accommodated to the customs of trade.

Our bushels, gallons, and quarts are in confusion not only in the United States but in Canada, the British Isles and the British Dominions. Standardization is, therefore, imperative. The rational thing to do is to bring bushels, gallons and quarts into aliquot relation to the foot cube as provided in the pending bill. It makes the bushel 1¼ cubes, the gallon one-eighth cube, or a cube of 6 inches in each dimension and the quart the one-fourth of a gallon or thirty-second of the foot cube. The tun of 32 foot cubes, may likewise be divided into 2 pipes, 4 hogsheads, 8 barrels, 16 casks, and 32 kegs of 1 cube capacity each.

The tun of 32 cubic feet, could take the place of the cubic yard of 27 cubic feet for the measure of sand, gravel, and excavated or dredged material.

Our dry measures would then have the following relations:

2 quarts equal 1 pot.
2 pots equal 1 gallon or 4 quarts.
2 gallons equal 1 peck or 8 quarts.
2 pecks equal 1 demicube or 16 quarts.
2 demicubes equal 1 cube, or keg, or 32 quarts.
1 cube equals 1 keg or 8 gallons.
2 kegs equal 1 cask, 2 cubes, or 16 gallons.
2 casks equal 1 barrel, 4 cubes, or 32 gallons.
2 barrels equal 1 hogshead, 8 cubes, or 64 gallons.
2 hogsheads equal 1 pipe, 16 cubes, or 128 gallons.
2 pipes equal 1 tun, 32 cubes, or 256 gallons.

The capacity of all irregular containers, casks, barrels, boxes, tubs, and tanks should be indicated in foot-cubes; and the capacity of all jars, cans, glasses, cups, bottles, baskets, buckets, ladles, and other receptacles should be indicated in decimal cubes or fluid ounces.

It is actually advantageous and logical that both the ton and the cube be divided into successive aliquot parts on the binary system. Thus the ton is divided in the proposed bill into 32 cube-weights, the tun into 32 foot-cubes, and the cube into 32 quarts.

A weight unit of wheat would be equivalent to 62½ avoirdupois pounds. A bushel of sound, plump wheat will weigh 62½ pounds, so that we have in the weight unit of the cube of water an approximate assimilation of the weight unit of 1,000 ounces to the bushel weight of sound wheat. It is probable there is no unit of weight so widely used in the world to-day as the bushel, and the weight unit proposed in the bill is quite exactly equivalent to the weight standard for a bushel of sound wheat. It is, therefore, equal to a weight measure of wide and almost universal use.

All scales constructed upon the avoirdupois system may be employed to measure the ounce units, which even now is a much more convenient unit for the retail sale than the pound. It would, of course, be a simple matter indeed to construct poids of 1,000 ounces or weight units for use on any scale constructed upon the avoirdupois system.

The decimal system of measures is epitomized in the following tables:

LINES.

10 points equal 1 line.
10 lines equal 1 decimal inch.
10 inches equal 1 foot.

SQUARES.

100 point squares equal 1 line square.
100 line squares equal 1 decimal square.
100 decimal squares equal 1 foot square.

CUBES.

1,000 point cubes equal 1 line cube.
1,000 line cubes equal 1 decimal cube.
1,000 decimal cubes equal 1 foot cube.

WEIGHTS.

1,000 point cubes equal 1 grain.
100 grains equal 1 dram.
10 drams equal 1 ounce.
1,000 grains equal 1 ounce.
10 ounces equal 1 decimal pound.
100 decimal pounds equal 1 weight unit.
1,000 ounces equal 1 weight unit.

LIQUIDS.

1 decimal cube equals 1 fluid ounce.
10 fluid ounces equal 1 pint.
100 pints equal 1 cube measure.
1,000 fluid ounces equal 1 cube measure.

The convenience of the decimal system is that the smaller decimal divisions may be used as units which are decimal parts of the higher unit, thus linear measures of the decimal system may be written in terms of the foot. For example, 5.126 feet means 5 feet 1 decimal inch 2 lines and 6 points. The small units, which are themselves decimal fractions of higher units, facilitate computations in the sciences and to a great extent in the arts and trades. The legal definition of decimal fractions will not, of course, interfere in anywise with the use of common fractions of any of the decimal units.

DECIMALS AND METRICS.

The American decimal system incorporated in the pending bill, proposes to assimilate the cubic inch to the avoirdupois ounce, which is the base of our present system of weights, and thus not only establishes the fundamental relation between the measures of length and the measures of weight, but also bring the inch, or the new decimal inch, into decimal relation to the foot, and thus make the foot and the avoirdupois ounce the basis of a real American decimal system of weights and measures, to correspond to our decimal system of coins and money.

The new decimal system retains the present foot, ounce, bushel, and ton, demands no radical alteration of the customs and measures of trade, but merely improves upon and coordinates these common measures in a truly decimal system, which composes the conveniences of the decimal notation, and the practical utility of the measures which have been sanctioned by custom and usage, and which have really become a part of the trading habits of the people.

The plain and inexorable fact is that the metric units are not of proper magnitudes for the purposes of mechanics, of construction or of commerce. The needs of mechanics and commerce are superior of those of the laboratory but decimalization of the foot will serve perfectly to accommodate the needs of both mechanics and science.

The metric units are absolutely arbitrary. They are in no sense practical, common, or customary. All measures, indeed, are artificial, but among them a preference is certainly to be accorded those which are common and customary, convenient, and practical and which have the sanction of long use and utility.

There is utterly no virtue in the metric system, outside of the decimal notation upon which it is arranged. The meter itself is an arbitrary misfit, and inconvenient unit or standard of measure. It doesn't fit anything that people ordinarily want to measure. The metric system has no measure between the centimeter, of 0.3937 inch, and the meter of 39.37 inches. It is perfectly obvious that neither a measure of 4 inches nor a measure of 40 inches will accommodate itself to the ordinary requirements for the standard unit of lenght. The meter is not to be compared in convenience to the foot. When we say foot, of course, we mean the common English foot of 12 inches.

The obvious preference of custom for the foot is not to be ignored. It is not a restricted or provincial view which declares the superiority of the foot over the meter. The fact is that every important country in the world had the foot as the customary unit. For example, the Roman pes is 11.65 inches, the Danish fod is 1.03 feet, the Swedish fot is 11.69 inches, the Norwegian fot is 12.35 inches, the Russian foute is 12 inches, the Rhine fuss is 1.03 feet, the Vienna fuss is 1.037 feet, the Portuguese or the Brazilian pé is 1.08 feet, the French pied is 1.066 feet, the Attic pous is 1.011 feet, the Olympic pous is 1.051 feet, the Japanese shaku is 0.994 foot, and the Chinese chih is 12.5 inches. It thus appears that every important country in the world adapted its customs of trade and mechanics to a measure analogous to and almost exactly comparable to our present English foot.

The fact is that the foot is one of the most venerable measures in the world and survived every test of convenience, usage, and practicality. The foot has become preferred to the yard, which is itself a measure of great antiquity and one of greater utility than the meter. The progressive preference of the foot over the yard clearly demonstrates the superiority of the foot as a common standard for longitudinal mensuration.

The basic unit of the metric system is really not the meter but the centimeter. The centimeter is divided into 10 millimeters, and multiplied by 100 to constitute the meter. The metric rod is graduated primarily into centimeters. The cubic centimeter of water is the gram, 1,000 grams constitute the kilogram, and 1,000 cubic centimeters constitute the liter. The centimeter is used in the metric system in the place of the foot and the inch of our common system. The proposal to establish the metric system as the exclusive system of weights and measures for the United States is a proposal to substitute the centimeter for the common foot and the inch. That is all there is to it.

The meter is too long and the centimeter is too short to be practicable for common measures. The foot is by far the better unit for customary use. The decimal inch is a better unit for scientific purposes than the centimeter, and the point is a far better unit for fine mechanical mensuration than the millimeter.

The cubic centimeter, with the gram derived from it, are too small for practical use and too large for the finest scientific uses. The decimeter is too large for fine uses in the mechanical trades and too small for practical measuring.

The liter is of no importance. It would be an imposition to confine the people to one measure for their transactions in fluid and dry commodities. It is just as fatuous to think of measuring wheat, potatoes, and cranberries exclusively by the liter as to measure them exclusively by the quart.

There is only one measure of any importance in the metric system, and that is the centimeter, 0.39370113 inch, and its derivative the cubic centimeter, which of water at maximum density, is the gram. These are to be compared with the standard foot and the ounce to determine the relative merits of the two systems. No other comparisons are called for or are appropriate.

For centuries scientists have used the ounce as the unit of weight, and the fluid ounce as the unit for liquids in the laboratory. The basic work of the masters has been done with these measures, and they have proven adequate for all purposes. It is admitted, however, that the cubic centimeter is a convenient measure for some scientific purposes, but neither cubic centimeters nor grams are superior to the new decimal grains and points for nice scientific uses. Indeed science may be served by the decimal cube or the ounce and their divisions quite as well, if not better, than by any of the metric measures.

The centimeter only varies by $\frac{63}{10,000}$ of an inch from one-third of the new decimal inch. Therefore, for all practical purposes 3 centimeters equal 1 decimal inch. The cubic centimeter of the laboratories may be thus assimilated to the cube of the third of the decimal inch. Where the cubic centimeter is specified or used, this will satisfy even scientific accuracy. The centimeter should therefore be defined by law as the third part of the decimal inch, and the remainder of the metric system should be discarded. The cubic centimeter could in this manner be retained as a fluid unit for the laboratory and for bacteriological tests. The cubic centimeter would bear the same relation to the decimal cube, which the cubic foot bears to the cubic yard. The ounce would equal 27 grams and the pound 432 grams derived from the American centimeter. Other metric measures derived from the American centimeter would be related to the decimal units as follows: Three centimeters equal 1 decimal inch, 3 decimeters equal to 1 foot, 3 meters equal 10 feet.

The decimal system does not yield thirds, so if we make of the decimeter merely a name for the third of the foot, and divide the new decimeter into four parts we obtain twelfths of the foot. And by dividing the new centimeter into four parts we would obtain twelfths of the decimal inch. And one-fourth of the centimeter would be precisely equal to one-tenth of the common inch. Decimeters and centimeters may thus be made to serve for the duodecimal division of the foot and the decimal inch, respectively. These metric units would have not an integral but only a fractional or ancillary relation to the decimal system. There could be brought about in this manner a correlation of the smaller metric and decimal units. This step should be taken to Americanize the metric system. The new American cubic centimeter ought not to be divided decimally but only by common fractions into halves, quarters, and eighths just as is now the practice in the laboratories. The new laboratory liter would be the cube of 4 common inches; and 27 liters would equal 1 cubic foot.

If the cubic centimeter has any utility because of its magnitude, its utility will not be impaired, but, indeed, will be advanced by defining it as the cube of the third of the decimal inch, and if the liter has any utility because of its magnitude, its utility will really be advanced by defining it as the cube of 4 inches, or the cube of the third of the foot.

The millimeter may be defined as the twenty-fourth part of the common inch, as has long been the practice with the continental instrument makers and lens grinders. The millimeter would thus be referred exclusively to the inch, the centimeter exclusively to the decimal inch, and the decimeter exclusively to the foot. Fractions of the common inch would then be precisely denoted in millimeters as follows:

$\frac{1}{2}$ inch equals 12 millimeters.
$\frac{1}{3}$ inch equals 8 millimeters.
$\frac{1}{4}$ inch equals 6 millimeters.
$\frac{1}{6}$ inch equals 4 millimeters.
$\frac{1}{8}$ inch equals 3 millimeters.
$\frac{1}{12}$ inch equals 2 millimeters.
$\frac{1}{16}$ inch equals $1\frac{1}{2}$ millimeters.
$\frac{1}{24}$ inch equals 1 millimeter.

The division of a decimeter rule into 4 inches and the graduation of the inches into twelfths and twenty-fourths would facilitate this use of the new millimeter.

The conversion of measures of volume into measures of weight is perfectly accommodated by the conversion of the decimal cube of water into the ounce. The conversion of the cubic centimeter of water into the gram, which is one of the points of the metric system upon which sedentary scientists delight to dwell, is not comparable in convenience or utility to the conversion of the decimal cube into the ounce. The ounce is by long odds a more appropriate magnitude for a practical unit of weight than is the gram. The ounce or decimal cube, moreover, is perfectly adapted as a measure for foods and commodities. It is a quantity that can be visualized and estimated. The gram, on the other hand, is simply a scientific obscurity which no cook or dealer can comprehend and which can be ascertained only by the use of instruments.

The new decimal "philosophical" pound of 10 ounces, specifically proposed by Watt in 1783 and which could well be called the "Watt pound" or "Watt," should, with its decimal drams and grains, displace grams, decigrams, centigrams, and milligrams, in the scientific laboratories. Watt intended that his philosophical pound should become the international scientific weight standard.

The English system of feet and inches is the system par excellence for mechanical and trade measures. The English system, however, does not have fine units adapted to the nice measurements required in the chemical and physical sciences, nor does it have the decimal notation to facilitate scientific computation. The decimalization of the foot into 1,000 points affords fine measures and weights, in a decimal relation, which are perfectly adapted to nice scientific and artistic uses. And these new decimal units are more practical and are of more appropriate magnitudes for use in the arts and sciences than are any of the metric units.

1,000 points equal one foot.
1,000,000 point squares equal one foot square.
1,000,000,000 point cubes equal one foot cube.

The metric system has nothing as nice as these measures.

And in the system of weights we have—

1,000 point cubes equal 1 decimal grain.
1,000 grains equal 1 ounce.
1,000 ounces equal 1 "weight" or weight unit.

The weight unit is the cube of water at maximum density. We have here a complete decimal correlation of weight units adapted perfectly to the needs of science, mechanics, and commerce.

It is not that the inch is the twelfth of the foot so much as that it is of a convenient mechanical magnitude, which gives it its chief value. It is true that the decimal inch invades the field of common inch, but the point enters a field altogether its own. The foot rule could on one side be graduated in common inches with the inches themselves graduated into halves, quarters, eighths, and sixteenths, and on the other side could be graduated into decimal inches, with the decimal inches graduated into tenths and twentieths, so that the same rule would be divided on opposite edges or sides, in both the decimal and duodecimal systems. Twentieths of 5 points each would afford even halves, quarters, fifths, and tenths of the decimal inch. Sixteenths would afford even halves, quarters, and eighths of the common inch.

The decimal inch which is equal to $1\frac{1}{5}$ common inches, is of a magnitude which is equal in utility to the common inch for mechanical purposes. Moreover the one-twentieth part of the decimal inch may be used interchangeably with one-sixteenth part of the common inch, as the difference between them is the difference between $\frac{1}{192}$ and $\frac{1}{200}$ of the foot; that is to say, one-sixteenth of the common inch only exceeds by $\frac{1}{4800}$ of a foot the one-twentieth part of the decimal inch, which is equal to one-half line or 5 points. In wood work and for many other practical uses, these measures may be regarded and used as equivalents.

The common fractions of the inch are equal to lines or tenths of the decimal inch as follows:

$\frac{1}{16}$ inch equals $\frac{1}{2}$ line or $5\frac{5}{24}$ points.
$\frac{1}{8}$ inch equals $1\frac{1}{24}$ lines or $10\frac{5}{12}$ points.
$\frac{1}{4}$ inch equals $2\frac{1}{12}$ lines or $20\frac{5}{6}$ points.
$\frac{1}{2}$ inch equals $4\frac{1}{6}$ lines or $41\frac{2}{3}$ points.
1 inch equals $8\frac{1}{3}$ lines or $83\frac{1}{3}$ points.

The decimal units founded upon the foot would be interchangeable without present common units and by evolution and custom, the less desirable units could go into obsolescense. To change common inches into decimal inches we have only to divide by 1.2, and to change decimal inches into common inches we only have to multiply by 1.2. Common fractions of the inch may thus be converted into terms of the foot and the decimal inch, and the common fractions of the foot may be converted into decimal fractions of the foot or decimal inches by the ordinary process of converting common fractions into decimal fractions. That is to say, by dividing the numerator by the denominator.

The foot accommodates itself to all that could be desired in a linear measure. The decimal inch is an ideal length unit for mechanical and scientific measurements. The cube of a decimal inch, or the ounce, is an ideal measure of weight for scientific uses and analysis. These units are superior for these purposes to any afforded by the metric system.

The meter itself has no intrinsic merit as a unit of measure and this is also true of the decimal divisions of the meter, the decimeter and the centimeter. They are not comparable in convenience to feet and inches or to the tenths, hundredths, or thousandths of the foot. The decimal inch or the tenth of the foot will be quite as convenient a measure as the old common inch. The use of both measures should be optional and custom should be free to indicate its preference between them or to use one or both.

It would really be a boon to the peoples of Europe and of Spanish America to return to the ancient Roman measures as standardized in England and North America. This is the one way to have a real, uniform, international standard and system. If our French friends were to take over our feet and points in place of the meter, decimeter, centimeter, and millimeter, and preferred to have decimal multiples of the foot, they may adopt a decaped of 10 feet, a centiped of 100 feet, and a milliped of 1,000 feet, in place of our yards, rods, and furlongs.

If we supplied these decimal multiples of the foot the analogy between the decimal system and the metric system would be complete as indicated in the following table:

point	.001	millimeter.
line	.01	centimeter.
decimal inch	.1	decimeter.
foot	1	meter.
decaped	10	decameter.
centiped	100	hektometer.
milliped	1000	kilometer.

The decimal magnitudes are, however, about 3½ times as fine as the corresponding metric magnitudes.

METRICS AND MECHANICS.

I desire to insert in the record at this point some statements of the views of practical mechanicians and men of science upon the impossibility of the use of the metric system in this country:

> I don't want any physicist or any professor or any astronomer, or astrologist from the skies to tell me what will go on in my works. I will tell them. I don't want any Government official or any subofficial from our new Department of Commerce and Labor to tell me what it will cost me. I will tell them. I don't propose for a moment to admit that the physicist, the scientest, and the astronomer can tell me anything about my business, because they don't know. And I regard it as an insult, as it would be for me to go and dictate to them about their astronomy or their particular science. (W. B. Cowles, vice president, Long Arm System Co.)
>
> There is no thought of doing this (adopting uniform screw thread standard) on any other basis than the English system. With the engineering societies of the two countries united in the establishment of English system standards, what sense is there in discussing the adoption of the metric system? If the United States and the British Government will join hands in promoting this work, as they have recently joined them in a still greater enterprise, the metric system will soon be relegated to the limbo of forgotten subjects of discussion. (Sir Archibald Denney.)
>
> Manufacturers do not object to anybody using the metric system who finds it more convenient. We do object most strongly however, to having chemists, astronomers,

and othere who know absolutely nothing of the details of manufacturing, try to dictate to us how to run our business. (Walter M. McFarland, vice president Westinghouse Electric & Manufacturing Co.

But, say the metricians, we want uniformity, well, in the English system of linear measurement we have uniformity. It presents the very ideal of uniformity. Throughout the United States and the British Empire, all English-speaking people on the globe, in their great variety of occupations, every man who measures anything for any purpose, all employ the same identical system of measurement. Its great practical excellence has compelled its universal adoption by men free to use the metric or any other system if they want to, and with the same freedom of choice, this excellence will make its use universal. (Charles T. Porter, past president American Society of Mechanical Engineers.)

And here is the crux of the whole matter. The units and subdivisions of the English system are founded on convenience and they continue in use because they are convenient. In the metric system one arbitrary unit has been created with the expectation that it will meet all demands. This unit is the meter. It is assumed to be the ten-millionth part of the earth's quadrant; but it is not. It is likewise assumed that the earth is an oblatespheroid; but it is not. It is assumed that the standard meter rod exactly represents the calculated meter; but it does not. It is also assumed that the kilogram is the exact weight of a cubic-decimeter; but it is not. What then, is the basis of the metric system? It is merely an arbitrary lineal unit that stands for nothing. (Jacques W. Redway, F. R. G. S.)

No other country has it (uniformity) to day, and no country has ever had it, except the United States and Great Britain. We have uniformity throughout this land. You ask us to discard it and to substitute confusion. We ask that you desist. We have to-day, barring the measures of volume, absolute uniformity throughout the United States and the entire British Empire, throughout the commercial China, and largely throughout Russia, whereas in all of the so-called metric countries the old units still persist, and in most of them the measures used by the people are not metric at all. (Henry R. Towne, president Yale & Towne Manufacturing Co.)

The metric system is not a convenient one for common use. The true scientific natural basis of the metric system has been abandoned. The meter is quite as arbitrary and unscientific as a standard as the foot or yard, and its compulsory adoption would derange the titles and records of every farm and every city and village lot in the United States; would put every merchant, farmer, and manufacturer and mechanic to an unnecessary expense and trouble, and all, it seems to me, for the sake of indulging a fancy only, and a baseless fancy of closet philosophers and mathematicians, for a scientific basis of measures and weights which is not what it professes to be. (M. C. Meigs, Quartermaster General, United States Navy.)

THE "NATURAL" BASIS OF THE METER.

The metric system is really the impractical relic of the atheistic aberrations of the French Revolution, which divided the year into a decade calendar of 10 months, put 10 days into the week, and attempted to divide the quadrant into 100 degrees. They made of the quadrant of the earth a centisimal of 10,000 units to which they gave the name of meters. In the French scheme the terrestrial circumference would equal 40,000,000 meters. The sapient, astral, absolutists who invented the metric system computed the quadrant to be 32,808,992 feet. Sir John Herschel subsequently computed the quadrant to be 32,813,000 feet. Therefore these sapient, astral, absolutists made an error of 4,008 feet in their calculations as to the length of the quadrant. The result is that the meter is one two hundred-eighth of an inch short of the theoretical standard to which it was to conform. The meter theoretically is a mere fantastic conception, actually it is an arbitrary measure preserved in a metallic rod kept at Sèvres near Paris.

The meter is not a customary but an arbitrary measure. It professes to have a natural basis. It ignores the fact that the function of standards of measuration is the measurement of artificial as distinguished from natural magnitudes. The standard must be convenient to the arts, instead of being accommodated in some fanciful fashion to nature, in which every quantity is relative and not absolute. It is utterly of no importance or signification that the primary unit of measure be an aliquot part of the quadrant of the earth, or that the quadrant be expressed in a decimal multiple of the primary unit of mensuration. The metric system would never have evolved out of the customs of trade and engineering practice. It is a highly arbitrary, unnatural, and impracticable system, one of the fancy inventions of the French communists. It is based upon the terrestrial measurement of the course of the meridian which passes from Barcelona on the Mediterranean to Dunkirk on the English Channel, and which traverses the Pyrenees Mountains and the western part of France. Astral observations at Barcelona and Dunkirk, the respective termini of this land line, were made and the relation of this segment of the quadrant to the whole determined and upon this basis the "length" of the quadrant was defined in terms of the measurements used on this terrestrial line. The divine, eternal, and scientific meter is the holy ten-millionth part of this quadrant.

If they had but taken the thirty millionth part of the quadrant, they would have hit upon something very near to the vulgar English foot. The meter is thus based upon a local and provincial measure in France. The thing has no more virtue than if it were based upon a line running north over Cape Cod or across Kamchatka. It is now positively known that the quadrant is not 10,000,000 meters. It is obvious, moreover, that the course of a meridian from any point on the equator to the pole is not a true line, it is merely a course bearing true north and following the terrestial curvature. Moreover the meridian from Barcelona to Dunkirk traverses the Pyrenees Mountains and other topographical interruptions, which interfere with mensuration in a true plane between these points.

The polar axis of the earth, which may be said to be a true line, has been computed to be 500,500,000 English inches. It would therefore be as sensible as was contended by Sir John Herschel, to define the inch as an aliquot of the polar axis, as to define the meter as an aliquot part of the quadrant. But the polar and equatorial axes of the earth are of different lengths. The chord of the quadrant would be a true line, but the quadrant itself, because of the curvature of the earth is not a true line. The chord of the quadrant is the hypotenuse of a right triangle of which the polar and equatorial radii are the respective legs, and the chord would therefore compose and equalize both these factors in terms of a true line between the pole and the equator, subject to neither topographical interruptions nor to a course which follows the terrestial curvature. It is evident that any theoretically true terrestial projection of a magnitude equal to the quadrant must, between its defined terminii, pass through the earth and not follow the superficial course of the meridian. The "line" from Barcelona to Dunkirk and to the pole describes only a segment of a great terrestial circle.

We in America might just as well run a line from Plymouth Rock to Powhatan's Tree, measure the distance between these terminii, and take an aliquot part of this distance, decimal or otherwise, to denote our American standard of mensuration. There would be as much sense in that, as there is in the French scheme, and it would, moreover, have the advantage of dependence upon an actual measurement instead of dependence upon a magnitude determined by astral observations. But what would be the advantage of measuring silk ribbons or wooden boards by either the polar or equatorial terrestrial circumference or any segment of the same? There is utterly no utility in such a performance. There would be as much reason and as much accuracy in taking an aliquot part of a linear projection to the moon. But the new theory of relativity would even preclude this from being a true line and hence it could not be a perfect base for an absolute standard of linear mensuration.

A straight line is an artificial, not a natural conception. An artificial foot or yard line, therefore, defined by an invariable metallic rod, is and must be the ultimate standard for artificial measures. The requirements of certainty, accuracy and invariability may only be served by having such an original metallic rod for the primary standard, and having the necessary duplicates made and multiplied from this standard. And as to what the primary standard should be, considerations of custom, utility and convenience are clearly to be preferred as the proper, practical and controlling factors. The foot meets admirably all these requirements. It is vain and needless to seek for any other primary standard. The French certainly had no right, to claim the fanciful, inconvenient, and impractical meter as the standard for universal and international application.

The metric system is in no wise essential to a true decimal system of weights and measures. A complete decimal system can be founded upon the foot with as much, if not more, facility than upon the meter. The metric system does not have a monopoly of decimal arithmetic, and it is a willful deception to propagate the idea that decimal is coterminous with metric, or that the money of the United States because it is decimal is metric, as is done by the catch words dollar, meter, liter, gram, used in metric propaganda.

There was a great deal of speculation at the end of the eighteenth century with respect to finding some definite measure in the natural world to which our artificial measures might be referred. There is obviously no such unit within the possibility of practical application. The most definite measure we have is that of time, made by the diurnal revolution of the earth, which we have divided into 86,400 seconds. The pendulum, adjusted to vibrate in seconds, has a definite length at a given altitude and latitude. The second pendulum vibrating in a vacuum at London is 39.13908 inches in length. The standard foot has been determined to be $\frac{10.000}{326159}$ of the second pendulum at London, and by this method the foot has been referred to the second pendulum just as definitely as though it were an aliquot part of the pendulum. The French had a chance to take the second pendulum and made it the meter, but Laplace and his committee declined to do so. The theoretical advantage of changing the foot to the one-third or one-fourth part of the second pendulum would in no wise compensate for the tremendous inconvenience which would result. The present relation between the foot and the ounce, by which the measures of weight may be derived from the measures of length, would be definitely dislocated. The proper plan, therefore, is to decimalize the common foot.

Metric propagandists claim that Thomas Jefferson was in favor of the adoption of the metric system. They say:

> The United States in 1796 adopted the metric system as to her coins. Thomas Jefferson advocated and urged that great progression.

It is true that Jefferson desired to refer the foot to the second pendulum and suggested that the foot be one-fifth of the second rod, which bears the relation to the second pendulum of 3 to 2 and which in the latitude of London has been computed to be 58.72368 inches. There would, however, be no present utility in using the third or the fourth of the second pendulum or the fifth of the second rod for our standard foot. These propagandists are too bold in claiming that Jefferson favored the legal adoption of the metric system of weights and measures for the United States. The plan he submitted to Congress in 1790 had nothing of the metric system in it. It was a decimal system based on feet, inches, lines, and points, and upon dollars, dimes, cents, and mills. The part providing for a decimal coinage was adopted, but it is utterly false to say that it was the metric system or that our coins are based upon the metric gram, for this is not the fact. Our coins were legally defined by Jefferson in terms of grains, and they are not gram weights, as is frequently asserted.

What Jefferson really thought of the French metric system is shown in a letter written to Dr. Patterson under date of Monticello, September 11, 1811, in which he said:

> I confess, indeed, I do not like the new system of French measures, because not the best, and adapted to a standard accessible to themselves exclusively, and to be obtained by other nations only from them. For, on examining the map of the earth, you will find no meridian on it but the one passing through their country offering the extent of land on both sides of the forth-fifth degree and terminating at both ends in a portion of the ocean, which the conditions of the problem for a universal standard of measures require. Were all nations to agree, therefore, to adopt this standard, they must go to Paris to ask it; and they might as well long ago have all agreed to adopt the French foot, the standard of which they could equally have obtained from Paris.

The metric system was put in force in France by compulsory decree. Even to-day the decimal divisions of the meter are ignored in practice in favor of half meters and quarter meters and in some of the French trades the ancient pouces, lines, and points persist to this day.

The greatest Frenchman of all time is Napoleon Bonaparte. Napoleon was a great and practical statesman as well as a great military commander. Napoleon never approved the adoption of the metric system in France, and he carried against the same an intense antipathy which lasted until his death at St. Helena. What Napoleon really thought of the metric system is disclosed by Gen. Gourgaud on page 86 of his book, Talks with Napoleon at St. Helena.

> WEIGHTS AND MEASURES.
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> I never have approved the system of weights and measures adopted by the directory, and invented by Laplace. It is all based on the meter and conveys no ideas to my mind. I can understand the twelfth part of an inch, but not the thousandth part of a meter (millimeter). The system created much dissatisfaction with the directory. Laplace himself assured me that if before its adoption, all the objections I made to it had been pointed out to him, he would have recognized its defects and have given it up.

In his memoirs of Napoleon, the Marquis de Montholon gives a statement of the objections of Napoleon to the establishment of the metric system in France.

IV. The want of uniformity in the French weights and measures is an inconvenience which has always been felt; it has several times been noticed by the States general. The revolution was expected to remedy this evil. The law on this subject was so simple that it might have been drawn up in the course of 24 hours, and adopted in practice throughout France in less than a year. The system of weights and measures used in the city of Paris ought to have been rendered common to all the Provinces. The Government and artists had for centuries used this system; and by sending standards into all the communes, and obliging the administrations and tribunals to admit no other weights or measures, the benefit would have been produced without effort, without difficulty, and without coercive laws. But geometricians and algebraists were consulted upon a question which was wholly within the province of administration. They thought that the unity of weights and measures ought to be deduced from natural principles, in order to secure its adoption by all nations. They conceived that it was not sufficient to confer a benefit on 40,000,000 of people, they wished the whole world to participate in it. They found that the meter was an aliquot part of the meridian; this they demonstrated and proclaimed in an assembly composed of French, Italian, Spanish, and Dutch geometricians. A new system of unity of weights and measures was thenceforth enacted, which neither agreed with the regulations of public administration, with the tables of dimensions used in all arts, nor with those of any of the existing machines. There was no real advantage to be expected from the extension of this system to the world in general. Besides, this scheme was impracticable; it would have been opposed by the national spirit of the English and Germans. Gregory VII, indeed, reformed the calendar, and rendered it common to all Europe; but this was because that reformation was connected with religious ideas, and was not effected by a nation, but by the power of the church. But in the new system, the good of the present generation was sacrificed to abstractions and vain hopes; for in order to make an ancient nation adopt a new system of weights and measures, all the regulations of government, and all the calculations of the arts, must be altered an undertaking the immensity of which startles the understanding. The new system of weights and measures, whatever it be, has an ascending and descending scale which does not agree in simple numbers with the scale of the systems of weights and measures which has for ages been used by the Government, by men of science, and by artists. The translation from one nomenclature to the other can not be made; because what is expressed by the simplest figure in the one, would become a compound cipher in the other. It is therefore necessary to increase or diminish by some fractions, so that the matter or weight expressed in the new nomenclature may be expressed in simple ciphers. Thus, for instance, a soldier's ration is expressed by 24 ounces in the old nomenclature: this is a very simple number; but when translated into the new one, it becomes 734.269 grams. It is therefore evident that it must be increased or diminished, to make it 734, or 735 grams. All the dimensions and lines that compose architectural works, all the tools and measures used in clock making, jewelry, paper making, and all the arts, all instruments and machines, had been invented and calculated according to the ancient nomenclature, and were expressed by simple numbers, which could only be translated by five or six figures. All was therefore to begin again.

The savants conceived another idea, wholly unconnected with the benefit of the unity of weights and measures; they adopted the decimal numeration, taking the meter for unity, and suppressed all complex numbers. Nothing can be more contrary to the organization of the mind, the memory, and the imagination. A fathom, a foot, an inch, a line, or a point, are fixed portions of extension, which the imagination conceives independently of their reciprocal relations; if, therefore, the third of an inch be demanded, the mind immediately acts, and divides the extent called an inch into three parts. But by the new system, the operation which the mind had to perform was not to divide an inch into three parts, but to divide a meter into 111 parts. The experience of all ages had so completely established the difficulty of dividing a space or a weight into a greater number of parts than 12, that a new complex name had been given to each of these divisions. If the twelfth of an inch were required, the operation was already performed; it was the complex number called a line. Decimal numeration applied to all the complex numbers as well as to unity; and if a hundredth part of a point or of a line was the quantity required, a hundredth was written: by the new system, if it is wished to express a hundredth part of a line, it is necessary to refer to its relation with the meter, which leads to an infinite calculation. The divisor 12 had been prefered to the divisor 10, because 10 has but two factors, 2 and 5, whilst 12 has four, viz, 2, 3, 4, and 6. It is true that decimal numeration, generalized and exclusively adapted to the meter as unity, facilities the labors of astronomers and calculators; but these advantages are far from compensating the disadvantage of rendering thought more difficult. The first object of every method ought to be to assist the conception and imagination, to facilitate recollection, and to increase the

> power of thought. Complex numbers are as old as man, because they are as inherent in the nature of his organization, as it is in the nature of decimal numeration to adapt itself to every unity, to every complex number, and not to one unity exclusively.
>
> Finally, they made use of Greek roots, which farther multiplied difficulties; for these denominations, although they might be useful to the learned, did not suit the people. The weights and measures were one of the principal affairs of the directory. Instead of leaving time to work the change, and merely encouraging the new system by all the power of example and fashion, they made compulsory laws, and had them rigorously executed. Merchants and citizens found themselves harassed about matters which were in themselves indifferent; and this increased the unpopularity of a government which placed itself above the wants and the reach of the people, infringing their usages, habits, and customs with all the violence that might have been expected from a Greek or Tartar conqueror, who, with the staff in his hand, insists upon obedience to all his commands, which are dictated only by his own prejudices and interests, to the total exclusion of those of the vanquished. The new system of weights and measures will be a subject of embarrassment and difficulties for several generations; and it is probable that the first learned commission employed to verify the measure of the meridian will find it necessary to make some corrections. Thus are nations tormented about trifles.

John Quincy Adams made a special study of the question of weights and measures after the adoption of the metric system in France. His views are interesting and valuable:

> It has been proved by the test of experience that the principle of decimal divisions can be applied only with many qualifications to any general system of metrology; that its natural application is only to numbers; and that time, space, gravity, and extension inflexibly reject its sway. The new metrology of France, after trying it in its most universal theoretical application, has been compelled to renounce it for all the measures of astronomy, geography, navigation, time, the circle, and the sphere; to modify it even for superficial, cubical, and linear measure, and to compound with vulgar fractions in the most ordinary and daily use, of all its weights and all its measures.
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> It is of little consequence to the farmer, who needs a measure for his corn, to the mechanic who builds a house, or to the townsman who buys a pound of meat or a bottle of wine, to know that the weight or the measure which he employs was standard by the circumference of the globe.

The librarian of one of the largest libraries in the country showed me a card from the card catalogue, with the size of the book indicated in centimeters and common fractions of the centimeter. He said that it all meant nothing to him. He understood octavo, and 12 mo., but did not understand centimeters. It seems that the American Library Association has taken on the affectation of using centimeters to indicate book sizes because it is "scientific," which in this sense signifies obscure. It is in order, of course, for the librarians to imitate the physicians in the use of a Latin and Greek nomenclature, which will keep their scientific knowledge exclusively within the profession. We are afflicted too much with the parrotic science which consists of chattering a lot of incomprehensible, unpronounceable, fanciful Greek compounds which mean nothing to anybody, not even to the parrots who affect to pronounce them and who scratch them in their books.

The peculiar nomenclature which has been adopted to denote the decimal arrangement of the metric system is so labored, mysterious, and formidable as to cause the ordinary person to instinctively react against it. The krazy kilos, kilograms, kiloliters, and kilometers ought to be enough to kill the whole fantastic system. This nomenclature has been carried to an extreme. It is perfect in its logical absurdity. Decimeters, decameters, deciliters, decaliters are confusing enough, but with hektometers, kilometers, miriameters, and hektoliters the system seems to be one of complete confusion. There formidable denotations are not to be compared with such terse, nice terms as foot, inch, yard, rod, mile, grain, ounce, point, and ton which are the customary and accepted terms for the units of weights and measures. The new decimal system founded upon and derived from the foot may with the utmost facility be applied in any country for the measurement of anything to which the metric units are now applied, and the return to the old common units of measurement which have survived even in France and in all metric countries to this day would be a most welcome reform to the people of all the so-called metric countries.

The elaborate tables prepared for the conversion of our common measures into metrics are upon casual examination utterly repellent to a practical man. His instinctive feeling and reaction is, "Oh, what is the use or the sense of it all?" It is singular that these tables are usually in form to convert common measures into metrics, which shows that the measures of primary importance are the common or English measures. The sensible man will just leave these tables alone.

Metric propagandists now confess the preference and superiority of the common or English weights and measures by proposing a world foot of one-third meter, a world inch of 25 millimeters, a world yard of 1 meter, a world quart of 1 liter, a world ounce of 30 grams, a world pound of 500 grams, a world hundredweight of 50,000 grams, a world mile of 1,000 meters, all of which is just a piece of impossible and impertinent nonsense. The English foot is now the world foot, the English inch is now the world inch, the English yard is now the world yard, the English ounce is now the world ounce, the English pound is now the world pound, and the English mile is now the world mile. The world will have no other feet, inches, yards, ounces, pounds, or miles.

To the zealots and partisans of the meter, the metric system is both scientific and natural, or is both scientifically natural and naturally scientific. The claim is made that men of science are generally in favor of the metric system. This may be true of some dilettante professors, but the fact is that the most solid men of science have been finally and intensely opposed to the metric system. Herbert Spencer carried his opposition to the metric system so far as to leave a bequest in his last will and testament for the republication of his pamphlet against the metric system. He directed that, in the event after his death that a bill were introduced in Parliament for the compulsory adoption of the metric system of weights and measures in Great Britain, that a copy of this pamphlet should be placed gratis in the hands of every member of both houses of Parliament and be sold to the public at a nominal price. Sir John Herschell shared with Spencer his intense opposition to the adoption of the metric system in England. We may place Spencer and Herschell against the authority of any of these professional metric propagandists, with a clear preponderance of scientific authority against the metric system.

METRIC PROPAGANDA.

The metric propaganda carried on by the so-called World Trade Club of San Francisco has led to an inquiry as to the activities carried on under this name. Investigators have made the following reports:

The World Trade Club is located in an office on Mission Street without any indication of its presence on the entrance of the door or elsewhere. A man connected with an advertising agency located there stated the funds for the work came from various societies throughout the world. (May 20, 1919.)

All this circularizing is financed by a rather mysterious individual named Z. He had paid about $80,000 to one local advertising firm and the total cost to date is around $100,000. No one at the address of the World Trade Club wanted to say anything. There are two theories about Mr. Z's purpose. He may be trying to improve the Allies foreign-trade balance by securing international adoption of the metric system, or he may be carrying out the hobby of a rich eccentric. (May 28, 1919.)

Mr. Z seems to have unlimited funds and pays promptly. He invariably desires to know the exact amount to be paid several days before the account is due. (June 23, 1919.)

Mr. Z has engaged the services of the Ramsey Mailing Co. to print, mail, and distribute a vast number of circulars, and this work is being paid for by Mr. Z. The name "World Trade Club" is adopted simply for convenience and to give more weight to the matter sent out than if it was signed by an individual. Mr. Z is doing this work quietly and has made no effort to gain the personal publicity which might easily have been his. (June 23, 1919.)

I have interviewed Mr. Z, who was the subject of our recent correspondence. Mr. Z is devoting a large part of his private fortune in presenting to the public arguments for the exclusive use of the metric units. Literature is being sent out under the name of the World Trade Club as a matter of convenience and to avoid the appearance of being the work of an individual, which, in Mr. Z's opinion, would detract from its effect. (July 14, 1919.)

The propaganda conducted in the name of the World Trade Club is so dishonest, misleading, and fictitious as to warrant the conclusion that there is some ulterior motive behind it.

The World Trade Club is a privately owned and operated propoganda agency. It is made of the same cloth as Friends of Peace, American Neutrality League, American Independence Union, Embargo Conference, American Truth Society, Labor's National Peace Council, and other professedly patriotic camouflages for German propaganda during the late war. The World Trade Club propaganda is just a meretricious scheme to open the markets of the United States to the metricised merchandise of Germany, and to handicap and thwart our own people in their own markets, in the confusion which would inevitably result from the compulsory application of the metric system to our industries and our commerce. The Germans desire to play the same game in the United States that they played in South America where they urged the purchase of German metric merchandise, as opposed to the merchandise in English measures, because the German merchandise conformed, as they said, to the official metric measures of the Latin-American countries. The World Trade Club is not interested in world trade for America, but in German trade in the United States.

MONEY AND COINAGE.

The bill also contains provisions which bring the gold coins of the United States into terms of the new decimal grain, without change in the absolute weight of the respective gold coins. The $5 piece is to be denominated the pound in place of the half eagle.

The silver dollar is to be coined at 1 ounce or 1,000 decimal grains, 900 fine. This is the equivalent of 437½ common grains. The act of February 12, 1873 (sec. 3520, Rev. Stat.), provided for the coinage of trade dollars of the weight of 420 grains, which is but 17½ common grains less than the weight prescribed for the new silver dollar to have a standard weight of 1 ounce. This act provided:

> Any owner of silver bullion may deposit same at any mint to be formed into bars, or into dollars of the weight of 420 grains, troy, designated in this title as trade dollars, and no deposit of silver for other coinage shall be received.

Until recent years the average value of silver was less than 50 cents per ounce troy, of 480 grains. The silver dollar was maintained at a parity with the gold dollar, or at the ratio of 16 to silver of 1 of gold, only by gold redemption at the Treasury. In other words, the silver dollar was kept at par by precisely the same process which is employed to keep the legal tender dollar notes of the United States at par—that is, by gold specie redemption and payment on demand. Under these conditions the Government could have given the silver dollars a weight of nearly 2 ounces without loss to itself. There would be, under normal conditions, no impediment in fixing the weight of the dollar at 1 ounce of 437½ common grains of silver 900 fine, whether there should or not be unlimited acceptance of silver bullion at the mints for coinage into dollars of this denomination. The ratio of value between a silver dollar of an ounce or $437\frac{5}{10}$ common grains 900 fine and the present gold dollar of $25\frac{8}{10}$ common grains 900 fine is as 16.95 to 1, which is a fair proximation to the traditional ratio of 16 to 1. It is not thought that silver will for many years, if ever again, fall below the relative value of 16.95 parts of silver to 1 part of gold.

The approximate equality in value between our 20-cent piece and the French franc and between our quarter and the English shilling has long since suggested the possibility and desirability of bringing the franc and the shilling into aliquot relation to the dollar. One of the greatest requirements of the times is a common international gold unit. The English have only to put in dollars of 1 ounce weight with 4 shillings equal to the dollar and the French have only to put in dollars of 1 ounce weight with 5 francs equal to the dollar in order to bring the common coins of America, Great Britain, and France into convenient aliquot relation.

The weights for the gold pounds of Great Britain and the United States need not be changed at present, but after the course of free financial exchange develops a stable relative value of gold to silver the propriety of assimilating the American half eagle, or $5 gold piece, to be called the American pound, and the English pound sterling to the same gold weight and value, may be properly considered. If the weight of the gold pound were fixed at 250 decimal grains of gold 900 fine, the coinage ratio of value between gold and silver would be 20 to 1 and the gold double eagle would have the same weight as the silver dollar. The gold weights, of course, could be fixed to accommodate the approximate actual value of gold in terms of silver, whatever that might be.

The ounce avoirdupois, which is the weight of the cube of the tenth of the foot of water at maximum density, should be made the international gold monetary unit, and pounds, dollars, and francs should be brought into aliquot relation to it. The table would then be 4 pounds equal 1 gold ounce or double eagle, 20 dollars equal 1 gold ounce, 100 francs equal 1 gold ounce.

Andrew Carnegie clearly perceived the value of a common system of measures, weights, and coins for the United Kingdom and the

United States. He was especially interested in assimilating the pound sterling to the American half eagle, and thus bringing the fractional coins of England and America into aliquot relation. Mr. Carnegie, in his biography of James Watt, says on this point, at page 176:

> As far as the English-speaking race is concerned, it seems that a decided improvement could readily be effected with very trifling, indeed scarcely perceptible, changes. Britain could merge her system with those of Canada and America by simply making her pound the exact value of the American $5, it being now only 10 pence less; her silver coinage, 1 and 2 shillings, equal to quarter and half dollars, the present coins to be recoined upon presentation but meanwhile to pass current. Weights and measures are more difficult to assimilate. Science being world wide and knowing no divisions, should have uniform terms. Alas, at the distance of nearly a century and one-half we seem no nearer a system of universal weights and measures than in Watt's day, but Watt's idea is not to be lost sight of for all that. He was a seer who often saw what was to come.

The clear conception of James Watt for a universal system of weights and measures based upon the foot and the ounce is, in the light of 150 years' experience, the only practicable plan for this purpose. The proposed system is entirely logical, consistent, and practical, and is built upon units long sanctioned by custom and utility. It brings order into our customary system of weights and measures and is formulated for this purpose. The time has come when Congress should exercise its constitutional power to establish a uniform, rationalized, decimalized system of measures and weights for the United States. The plan proposed offers the only alternative to the metric system, and is superior from every point of view to the metric system for our country. It is also intrinsically superior as the standard for a true international system of measuration.

I will insert in the record at this point a proposed, revised, amendatory form of H. R. 12850:

A BILL To establish the standard and decimal divisions of the weights, measures, and coins of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the standard of the weights, measures, and coins of the United States, and the decimal divisions thereof, shall, after the 1st day of January, 1921, be as follows:

Sec. 2. The standard for the measure of length shall be the foot as heretofore commonly used and established as a measure of length in the United States of America, and which is the standard foot of the United Kingdom of Great Britain and Ireland.

The decimal divisions of the foot shall be the tenth or decimal inch, the hundredth or line, and the thousandth or point, of which ten points equal one line, ten lines equal one decimal inch, and ten decimal inches equal one foot. One hundred points equal one decimal inch and one thousand points equal one foot. The centimeter is the third part of the decimal inch. The common inch is the twelfth part of the foot.

The common multiples of the foot are the yard, the fathom, the rod, the furlong, and the mile, of which the yard equals three feet, the fathom equals six feet, the rod equals sixteen and one-half feet, the furlong equals forty rods, and the mile equals three hundred and twenty rods.

Sec. 3. The standard for the measure of plane surfaces shall be the square of the foot, which shall be designated the square. The decimal division of the square shall be the square of the decimal inch, which shall be designated the decimal square, and of which one hundred decimal squares equal one square.

The squares of the respective multiples and divisions of the foot may be used for the measurement of plane surfaces.

The standard for the measure of land surfaces shall be the acre of one hundred and sixty square rods. The square furlong equals ten acres. The acre-foot is the measure of water, having a surface of one acre and a depth of one foot.

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